The formulæ of these substances are—

Chloride of Auro-phosphethylium.. $\left.\begin{matrix}\mathrm{Au}\\ \mathrm{E}\\ \mathrm{E}\\ \mathrm{E}\end{matrix}\right\}\mathrm{P\,Cl.}$

Chloride of Auro-arsethylium .... $\left.\begin{matrix}\mathrm{Au}\\ \mathrm{E}\\ \mathrm{E}\\ \mathrm{E}\end{matrix}\right\}\mathrm{As\,Cl.}$

Chloride of Auro-stibethylium..... $\left.\begin{matrix}\mathrm{Au}\\ \mathrm{E}\\ \mathrm{E}\\ \mathrm{E}\end{matrix}\right\}\mathrm{Sb\,Cl.}$

The complementary products formed in these reactions remain in the mother liquors of the several salts, from which they separate in the form of oily compounds which gradually solidify into crystalline masses. These I have not yet examined.

A glance at the above formulæ shows that the new compounds which form the subject of this note correspond to the chloride of platammonium,

$$\left.\begin{matrix}\mathrm{Pt}\\ \mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\mathrm{N\,Cl.}$$

It remains to be ascertained whether the chloride of plato-diammonium,

$$\left.\begin{matrix}\mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\mathrm{N}\left.\begin{matrix}\mathrm{Pt}\\ \mathrm{H}\\ \mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\mathrm{N\,Cl,}$$

is likewise represented in the phosphorus-, arsenic-, and antimony-series.

VII. "On a New Series of Compounds derived from Ammonia and its Analogues." By Edward Frankland, Ph.D., F.R.S. Received June 18, 1857.

Although zincethyl and its homologues are now well known to be capable of replacing electro-negative elements by ethyl, &c., yet it could scarcely have been anticipated, that substitutions of an almost opposite character would be effected by the same reagent; neverthe-

less I find that zincethyl is capable of removing one of the atoms of hydrogen in ammonia and its analogues, and of replacing it by zinc, thus forming a series of bodies which strongly remind us of the amide and nitride of potassium. The general nature of this reaction by which the compounds described below are produced, may be thus expressed:—

$$N\left\{\begin{matrix} x \\ y \\ H \end{matrix} + \begin{matrix} Zn \\ C_4H_5 \end{matrix}\right\} = N\left\{\begin{matrix} x \\ y \\ Zn \end{matrix} + \begin{matrix} C_4H_5 \\ H \end{matrix}\right\}.$$

When dry ammoniacal gas is passed through an ethereal solution of zincethyl, it is rapidly absorbed, and soon afterwards torrents of a combustible gas free from nitrogen begin to be evolved. After the current has been continued for more than an hour, the absorption altogether ceases, and the ethereal liquid deposits a copious white amorphous precipitate, which yielded on analysis numbers leading to the formula

$$N\left\{\begin{matrix} H \\ H \\ Zn. \end{matrix}\right.$$

The analysis of the combustible gas proved that 1 vol. consumed 3·43 vols. oxygen, and generated 1·95 vol. carbonic acid; numbers almost identical with those yielded by hydride of ethyl, with which the gas is also identical in specific gravity. These results prove that zincethyl acts upon ammoniacal gas in the following manner:—

$$N\left\{\begin{matrix} H \\ H \\ H \end{matrix} + \begin{matrix} Zn \\ C_4H_5 \end{matrix}\right\} = N\left\{\begin{matrix} H \\ H \\ Zn \end{matrix} + \begin{matrix} C_4H_5 \\ H \end{matrix}\right\}.$$

The solid product of the reaction, for which I propose the name *zincamide*, is a white amorphous body insoluble in ether, and instantly decomposed by water and alcohol, with evolution of great heat, and in such a manner as to regenerate ammonia. Thus with water the following equation expresses the reaction:—

$$N\left\{\begin{matrix} H \\ H \\ Zn \end{matrix} + \begin{matrix} H \\ H \end{matrix}\right\} O_2 = N\left\{\begin{matrix} H \\ H \\ H \end{matrix} + \begin{matrix} Zn \\ H \end{matrix}\right\} O_2.$$

Heated with iodide of ethyl in a sealed tube at 145° C., zincamide gives iodide of zinc and iodide of diethylammonium—

$$N\left\{\begin{matrix} H \\ H \\ Zn \end{matrix} + 2\begin{matrix} C_4H_5 \\ I \end{matrix}\right\} = N(C_4H_5)_2H_2I + ZnI.$$

Nitride of Zinc.

Zincamide can bear a temperature of 200° C. without decomposition, but at a low red heat it is decomposed into nitride of zinc and ammonia:—

$$3N\left\{\begin{matrix}H\\H\\Zn\end{matrix}\right. = 2N\left\{\begin{matrix}H\\H\\H\end{matrix}\right. + N\left\{\begin{matrix}Zn\\Zn\\Zn.\end{matrix}\right.$$

Nitride of zinc is a grey pulverulent body, which is neither fused, decomposed, nor volatilized at a red heat out of contact with air. It is decomposed by water with great violence; in fact, if the nitride be merely moistened with water, it becomes red-hot. Several analyses prove that the formula of nitride of zinc is

$$N\left\{\begin{matrix}Zn\\Zn\\Zn.\end{matrix}\right.$$

The study of the products of its decomposition by water shows that the reaction may be thus expressed:—

$$N\left\{\begin{matrix}Zn\\Zn\\Zn\end{matrix}\right. + 6HO = N\left\{\begin{matrix}H\\H\\H\end{matrix}\right. + 3\left\{\begin{matrix}Zn\\H\end{matrix}\right\} O_2.$$

Zincphenylimide.

$$N\left\{\begin{matrix}C_{12}H_5\\H\\Zn.\end{matrix}\right.$$

This body is produced by the action of zincethyl upon anhydrous aniline. The reaction is so violent that it requires to be moderated by diluting the zincethyl with ether. Heat is evolved, and a large quantity of a combustible gas is rapidly generated. At length the liquid becomes a white, semisolid, opake mass. Analysis proved the gas to be pure hydride of ethyl, whilst the solid body regenerated aniline in contact with water. The production of zincphenylimide may therefore be thus expressed:—

$$N\left\{\begin{matrix}C_{12}H_5\\H\\H\end{matrix}\right. + \left\{\begin{matrix}Zn\\C_4H_5\end{matrix}\right\} = N\left\{\begin{matrix}C_{12}H_5\\H\\Zn\end{matrix}\right. + \left\{\begin{matrix}C_4H_5\\H\end{matrix}\right\}.$$

Zincphenylimide is a white amorphous body very similar to zinc-

amide. Like the latter body, it is instantly decomposed by water, aniline being regenerated :—

$$N\left\{\begin{matrix}C_{12}H_5\\H\\Zn\end{matrix}\right\}+\left\{\begin{matrix}H\\H\end{matrix}\right\}O_2=N\left\{\begin{matrix}C_{12}H_5\\H\\H\end{matrix}\right\}+\left\{\begin{matrix}Zn\\H\end{matrix}\right\}O_2.$$

Diethylzincamine.

$$N\left\{\begin{matrix}C_4H_5\\C_4H_5\\Zn.\end{matrix}\right.$$

This body is produced by the action of zincethyl upon diethylamine. The reaction requires to be aided by heat. Pure hydride of ethyl is evolved, and the following equation expresses the reaction :—

$$N\left\{\begin{matrix}C_4H_5\\C_4H_5\\H\end{matrix}\right\}+\left\{\begin{matrix}Zn\\C_4H_5\end{matrix}\right\}=N\left\{\begin{matrix}C_4H_5\\C_4H_5\\Zn\end{matrix}\right\}+\left\{\begin{matrix}C_4H_5\\H\end{matrix}\right\}.$$

Its reactions are quite similar to those of the bodies above described.

Zincoximide.

$$N\left\{\begin{matrix}C_2O_2\\H\\Zn.\end{matrix}\right.$$

Dry oxamide and pure zincethyl are without any action upon each other at ordinary temperatures, but the heat of a water-bath is sufficient to establish a violent reaction, torrents of pure hydride of ethyl are evolved, and zincoximide combined with zincethyl remains in the retort. The following equation expresses the reaction :—

$$N\left\{\begin{matrix}C_2O_2\\H\\H\end{matrix}\right\}+2(ZnC_4H_5)=N\left\{\begin{matrix}C_2O_2\\H\\Zn\end{matrix}\right\}+\left\{\begin{matrix}Zn\\C_4H_5\end{matrix}\right\}+\left\{\begin{matrix}C_4H_5\\H\end{matrix}\right\}.$$

Zincacetimide.

$$N\left\{\begin{matrix}C_4H_3O_2\\H\\Zn.\end{matrix}\right.$$

Acetamide and zincethyl act upon each other very violently ; a large quantity of gas is evolved, which analysis proves to be hydride of ethyl. Zincacetimide is contained in the residue as a white, amor-

phous, pulverulent solid, which is reconverted into acetamide by contact with water.

These reactions establish the fact, that by the action of zincethyl one of the atoms of hydrogen, in ammonia and analogous nitrogen compounds, combines with ethyl and becomes replaced by zinc. It will be interesting to extend this reaction to the nitryles, especially such as contain electro-negative radicals of the othyl family, since we may thus expect to obtain a new series of double radicals, amongst which the ketones will perhaps find a home. I hope soon to lay the results of this extension of the investigation before the Royal Society.

VIII. "On a Class of Dynamical Problems." By Arthur Cayley, Esq., F.R.S. Received June 18, 1857.

There are a class of dynamical problems which, so far as I am aware, have not been considered in a general manner. The problems referred to (which might be designated as continuous-impact problems) are those in which the system is continually taking into connexion with itself particles of infinitesimal mass (*i. e.* of a mass containing the increment of time dt as a factor), so as not itself to undergo any abrupt change of velocity, but to subject to abrupt changes of velocity the particles so taken into connexion. For instance, a problem of the sort arises when a portion of a heavy chain hangs over the edge of a table, the remainder of the chain being coiled or heaped up close to the edge of the table; the part hanging over constitutes the moving system, and in each element of time dt, the system takes into connexion with itself, and sets in motion with a finite velocity an infinitesimal length ds of the chain; in fact, if v be the velocity of the part which hangs over, then the length vdt is set in motion with the finite velocity v. The general equation of dynamics applied to the case in hand will be

$$\Sigma\left\{\left(\frac{d^2x}{dt^2}-\mathrm{X}\right)\delta x+\left(\frac{d^2y}{dt^2}-\mathrm{Y}\right)\delta y+\left(\frac{d^2z}{dt^2}-\mathrm{Z}\right)\delta z\right\}dm$$

$$+\Sigma\left(\Delta u\delta\xi+\Delta v\delta\eta+\Delta w\delta\zeta\frac{1}{dt}\right)d\mu=0,$$

where the first line requires no explanation, in the second line ξ, η, ζ